Reclamation Research Annual Report — 1985

Alberta
ENVIRONMENT
Environmental Evaluation Services
Land Conservation and
Reclamation Council

Office of J.M. King, Chairman

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February 3, 1987

Honourable K. Kowalski
Minister of the Environment
132 Legislature Building
Edmonton, Alberta
T5K 2B6

Dear Sir:

Enclosed is the "Reclamation Research Annual Report - 1985".

This Program Status Report was prepared by the Reclamation Research Technical Advisory Committee under the direction of the Land Conservation and Reclamation Council.

Yours truly,

J.M. King, P.Ag.
Chairman

Enclosure

RECLAMATION RESEARCH

ANNUAL REPORT

1985

REPORT # RRTAC 86-8

Prepared

by

Paul F. Ziemkiewicz, Chairman

Reclamation Research Technical Advisory Committee

of the

Alberta Land Conservation & Reclamation Council

31 March 1986

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INTRODUCTION

The regulation of surface disturbances in Alberta is the responsibility of the Land Conservation and Reclamation Council. The Council executive consists of a chairman from the Department of the Environment and two deputy chairmen from the Department of Energy and Natural Resources. Among other functions, the Council oversees programs for reclamation of abandoned disturbances and reclamation research. The reclamation research program was established to identify the most efficient methods for achieving acceptable reclamation. Funds for implementing both the operational and research programs are drawn from Alberta's Heritage Savings Trust Fund.

To assist in technical matters related to the development and administration of the research program the Council appointed the Reclamation Research Technical Advisory Committee (RRTAC). The Committee first met in March, 1978 and consists of eight members representing the Alberta Departments of Agriculture, Energy and Natural Resources, Environment and the Alberta Research Council. The Committee meets regularly to up-date research priorities, review solicited and unsolicited research proposals, arrange workshops and otherwise act as a referral and coordinating body for reclamation research.

Our Reclamation Research Projects are trials for new technologies and new proposals are reviewed and rated on their adherence to priorities, likelihood of success and competence of researchers. Throughout the review process the key question is: "Would this technology make reclamation in Alberta a more efficient process?"

Research projects results are made available through publication and distribution of Reclamation Research Reports. The following section is a listing of available reports.

Additional information on the Reclamation Research Program may be obtained by contacting:

Dr. Paul F. Ziemkiewicz, Chairman
Reclamation Research Technical Advisory Committee
2nd Floor, Pacific Plaza
10909 Jasper Avenue
EDMONTON, Alberta
T5J 3M8

RECLAMATION RESEARCH REPORTS

			REPORT NO.
*1.	TITLE:	The Role of Organic Compounds in Salinization of Plains Coal Mining Sites.	RRTAC 80-3
	AUTHOR(S):	N.S.C. Cameron et al.	
	DESCRIPTION:	This is a literature review of the chemistry of sodic mine spoil and the changes expected to occur in groundwater. 46 p.	
*2.	TITLE:	Proceedings: Workshop on Reconstruction of Forest Soils in Reclamation.	RRTAC 80-4
	AUTHOR(S):	P.F. Ziemkiewicz, S.K. Takyi, H.F. Regier	
	DESCRIPTION:	Experts in the Field of Forestry and Forest Soils Report on Research relevant to Forest Soil Reconstruction and discuss the most effective means of restoring forestry capability of mined lands. 160 p.	
*3.	TITLE:	Manual of Plant Species Suitability for Reclamation in Alberta, 2 Vols.	RRTAC 80-5
	AUTHOR(S):	L.E. Watson, R.W. Parker, P.F. Polster	
	DESCRIPTION:	Forty-three grass, fourteen forb and thirty-four shrub and tree species are assessed in terms of their fitness for use in Reclamation. Range Maps, Growth Habit, Propagation, Tolerances and Availability. 541 p.	
*4	TITLE:	1980 Survey of Reclamation Activities in Alberta	RRTAC 81-2
	AUTHOR(S):	D.G. Walker, R.L. Rothwell	
	DESCRIPTION:	This survey is an update of the original Report conducted in 1976 on Reclamation Activities in Alberta, includes Research and Operational Reclamation, locations, personnel etc. 76 p.	

Available from: Publication Services
Queen's Printer
11510 Kingsway Avenue
EDMONTON, Alberta T5G 2Y5

* A $5.00 fee is charged for handling and postage.
** A $20.00 fee is charged for handling and postage.

Please make cheque payable to: "Provincial Treasurer of Alberta"

	RECLAMATION RESEARCH REPORTS Cont'd.		REPORT NO.
*5.	TITLE:	Proceedings: Workshop on Coal Ash and Reclamation.	RRTAC 81-3
	AUTHOR(S):	P.F. Ziemkiewicz, R. Stien, R. Leitch, G. Lutwick	
	DESCRIPTION:	Presents nine technical papers on the Chemical, Physical and Engineering Properties of Alberta Fly and Bottom Ashes, Revegetation of Ash Disposal Sites and Use of Ash as a Soil Amendment. Workshop discussions and summaries are also included.	
*6.	TITLE:	Land Surface Reclamation: An International Bibliography. 2 Vols.	RRTAC 82-1
	AUTHOR(S):	H.P. Sims, C.B. Powter	
	DESCRIPTION:	Literature pertinent to Reclamation in Alberta is listed in Vol. 1 and is also on the University of Alberta Computing System. The Keyword Index and Computer Access Manual comprises Vol. 2. 292 p.	
*7.	TITLE:	A Bibliography of Baseline Studies in Alberta: Soils Geology, Hydrology and Groundwater.	RRTAC 82-2
	AUTHOR(S):	C.B. Powter, H.P. Sims	
	DESCRIPTION:	This Bibliography provides baseline information for persons involved in Reclamation Research or in the Preparation of Environmental Impact Assessments. Materials, up to date as of Dec. 1981 are available from the Alberta Environmental Library. 97 p.	
*8	TITLE:	Soil Reconstruction Design for Reclamation of Oil Sand Tailings.	RRTAC 83-1
	AUTHOR(S):	Monenco Consultants Ltd.	
	DESCRIPTION:	Volumes of Peat and Clay required to amend Oil Sand Solid Tailings were estimated based on existing literature. Separate soil prescriptions were made for Spruce, Jack Pine and Herbaceous cover types. The estimates form the basis of recently initiated field trials. 185 p.	

RECLAMATION RESEARCH REPORTS Cont'd. **REPORT NO.**

*9. TITLE: Evaluation of Pipeline Reclamation Practices on Agricultural Lands in Alberta. RRTAC 83-3

AUTHOR(S): Hardy Associates (1978) Ltd.

DESCRIPTION: Available information on Pipeline Reclamation practices was reviewed. A field survey was then conducted to determine the effects of pipe size, age, soil type construction method etc. on resulting crop reproduction. 205 p.

*10. TITLE: Proceedings: Effects of Coal Mining on Eastern Slopes Hydrology RRTAC 83-4

AUTHOR(S): P.F. Ziemkiewicz

DESCRIPTION: Technical Papers are presented dealing with the impacts of Mining on Mountain Watersheds, their flow characteristics and resulting water quality. Mitigative measures and Research priorities were also discussed. 123 p.

*11. TITLE: Woody Plant Establishment and Management for Oil Sands Mine Reclamation. RRTAC 83-5

AUTHOR(S): Techman Engineering Ltd.

DESCRIPTION: This is a review and analysis of information on planting stock quality, rearing site preparation, planting and procedures necessary to ensuring survival of trees and shrubs in oil sand reclamation. 124 p.

**12. TITLE: Land Surface Reclamation: A Review of International Literature. 2 Vols. RRTAC 84-1

AUTHOR(S): H.P. Sims, C.B. Powter, J.A. Campbell

DESCRIPTION: Nearly all topics of interest to Reclamation includes Mining Methods to Soil Amendments, Revegetation, Propagation and Toxic Materials are reviewed in light of the International Literature. 1549 p.

		RECLAMATION RESEARCH REPORTS Cont'd.	REPORT NO.
*13.	TITLE:	Propagation Study: Use of Trees and Shrubs for Oil Sand Reclamation	RRTAC 84-2
	AUTHOR(S):	Techman Engineering Ltd.	
	DESCRIPTION:	This Report evaluates and summarizes all available published and unpublished information on large-scale propagation methods for shrubs and trees to be used in Oil Sand Reclamation.	
*14.	TITLE:	Soil Microbiology in Land Reclamation. 2 Vols.	RRTAC 84-4
	AUTHOR(S):	D. Parkinson, R.M. Danielson, C. Griffiths, S. Visser and J.C. Zak	
	DESCRIPTION:	This is a collection of five Reports dealing with Reestablishment of Fungal Decomposers and Mycorrhizal Symbionts in various amended spoil types. 676 p.	
*15.	TITLE:	Proceedings: Revegetation Methods for Alberta's Mountains and Foothills	RRTAC 85-1
	AUTHOR(S):	P.F. Ziemkiewicz	
	DESCRIPTION:	Results of long-term experiments and field experience on Species Selection, Fertilization, Reforestation, Topsoiling Shrub Propagation and Establishment are presented.	
*16.	TITLE:	Reclamation Research Annual Report - 1984	RRTAC 85-2
	AUTHOR(S):	P.F. Ziemkiewicz	
	DESCRIPTION:	This Report details the Reclamation Research Program indicating priorities, descriptions of each Research Project, researchers, results and expenditures. 29 p.	

		RECLAMATION RESEARCH REPORTS Cont'd	REPORT NO.
*17.	TITLE:	A Critical Analysis of Settling Pond Design and Alternative Technologies	RRTAC 86-1
	AUTHOR:	A. Somani	
	DESCRIPTION:	This is the first report resulting from the mountain & Foothills Reclamation Research Program to The Coal Association of Canada contributes 50% of the funds. The report examines the critical issue of Settling Pond Design and Sizing and Alternative Technologies. An executive summary outlines the findings.	
*18.	TITLE:	Characterization and Variability of Soil Reconstructed after Surface Mining in Central Alberta.	RRTAC 86-2
	AUTHOR:	T.M. Macyk	
	DESCRIPTION:	Reconstructed soils representing different materials handling and replacement techniques were characterized and variability in chemical and physical properties was assessed. The data obtained indicate that reconstructed soil properties are determined largely by parent material characteristics and further tempered by materials handling procedures. Mining tends to create a relatively homogeneous soil landscape in contrast to the mixture of diverse soils found before mining.	
*19.	TITLE:	Generalized Procedures for Assessing Post-Mining Groundwater Supply Potential in the Plains of Alberta - Alberta Research Council - Plains Hydrology and Reclamation Project.	RRTAC 86-3
	AUTHOR:	M.R. Trudell, S.K. Moran	
	DESCRIPTION:	In the plains region of Alberta, the surface mining of coal generally occurs in rural, agricltural areas in which domestic water supply requirements are met almost entirely by groundwater. Consequently, an important aspect of the capability of reclaimed lands to satisfy the needs of a residential component is the post-mining availability of groundwater. This report proposes a sequence of steps or procedures to identify and characterize potential post-mining aquifers.	

		RECLAMATION RESEARCH REPORTS Cont'd	REPORT NO.
*20.	TITLE:	Geology of the Battle River Site: Plains Hydrology and Reclamation Project	RRTAC 86-4
	AUTHOR:	A. Maslowski-Schutze, R.Li, M. Fenton, S.R. Moran	
	DESCRIPTION:	This report summarizes the geological setting of the Battle River study site. It is designed to provide a general understanding of geological conditions adequate to establish a framework for hydrogeological and general reclamation studies. The report is not intended to be a detailed synthesis such as would be required for mine planning purposes. 86 p.	
*21.	TITLE:	Chemical and Mineralogical Properties of Overburden: Plains Hydrology and Reclamation Program	RRTAC 86-5
	AUTHOR:	A. Maslowski-Schutze	
	DESCRIPTION:	This report describes the physical and mineralogical properties of overburden materials in an effort to identify individual beds within the bedrock overburden that might be significantly different in terms of reclamation potential.	
*22	TITLE:	Post-Mining Groundwater Supply at the Battle River Site: Plains Hydrology and Reclamation Project. 60 p.	RRTAC 86-6
	AUTHOR:	M.R. Trudell, G.J. Storenberg and S.R. Moran	
	DESCRIPTION:	The report deals with the availability of water supply in or beneath cast overburden at the Battle River Mining area in east-central Alberta to support post-mining land use. Both groundwater quantity and quality are evaluated. 49 p.	
*23	TITLE:	Post-Mining Groundwater Supply at the Highvale Site: Plains Hydrology and Reclamation Project.	RRTAC 86-7
	AUTHOR:	M.R. Trudell	
	DESCRIPTION:	This report evaluates the availability of water supply in or bencath cast overburden to support post-mining land use, including both quantity and quality considerations. The study area is the Highvale mining area in west-central Alberta. 26 p.	

MINING AND RECLAMATION IN ALBERTA

Most of Alberta's industrial activity occurs in three major biophysical regions: The Plains, where most of the Province's agricultural land is located, the Mountains and Foothills where recreation, forestry, wildlife and watershed values are predominant, and Northeast Alberta, where wildlife and forestry values exist.

Coinciding with these regions are three major disturbance types:

1) **Plains:** Coal Mines operated in conjunction with electrical generating plants,

2) **Mountains and Foothills:** Metallurgical coal mines and high quality thermal coal for export, and

3) **Northeast Alberta:** Oil sand mining and extraction facilities.

While it is expected that research results will often have province-wide application, the division of the program among the three biophysical regions has proven helpful in identifying priorities and directions for the research program.

THE RESEARCH PROGRAM

Following is a summary of research projects as of March, 1986. Project titles are followed by the names of the principal investigators and their affiliation.

Upon project completion a final report is submitted. Some final reports are published intact as RRTAC Reports and released to the public. Others are held pending their inclusion in comprehensive RRTAC Reports.

1. PLAINS

Reclamation Objectives

To return crop land to pre-mining levels of productivity. Productivity is taken to include both agricultural and hydrologic capabilities.

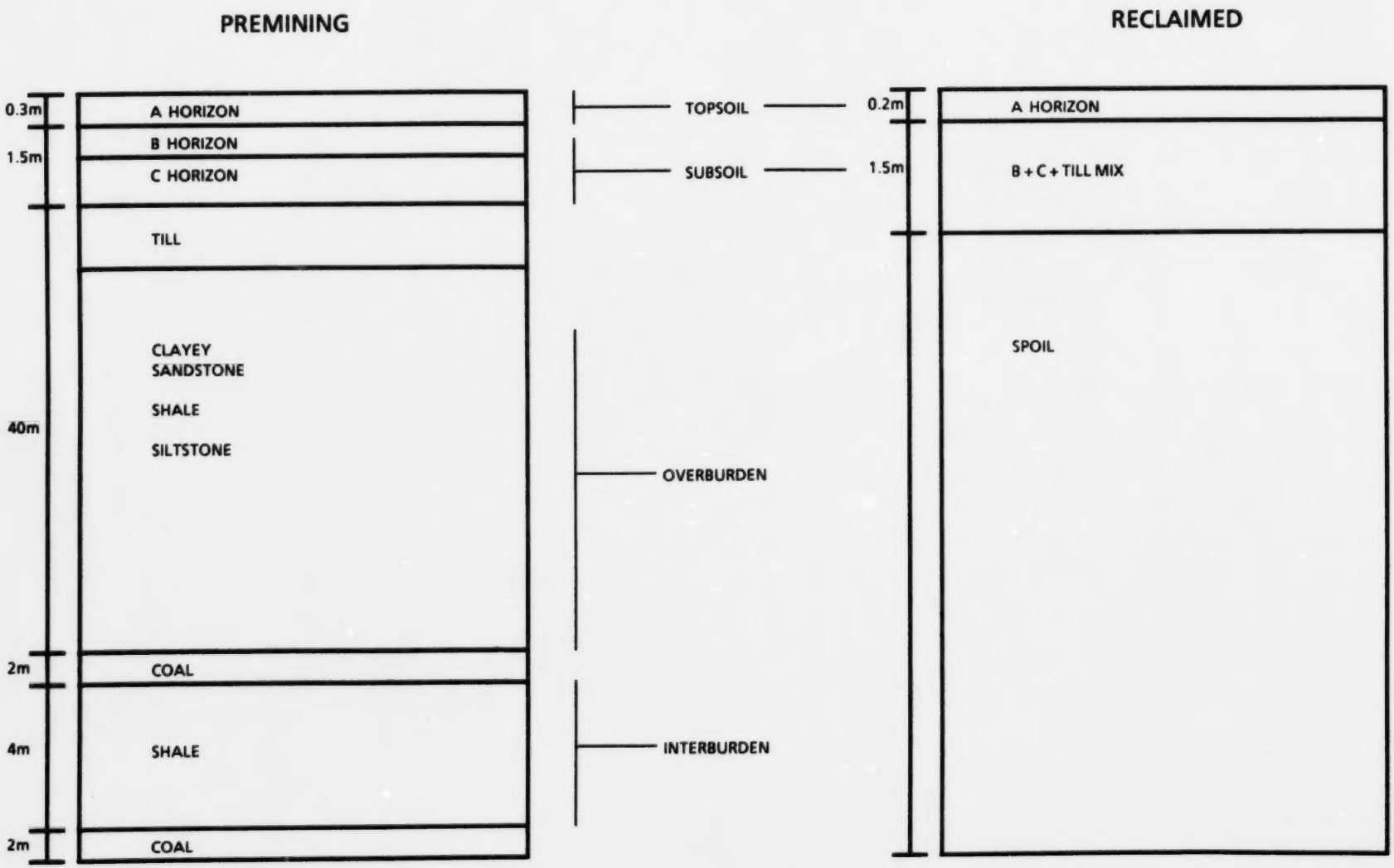
The Problem

The plains coal seams are usually overlain by bedrocks which contain a high proportion of swelling clays. When exposed to the elements the bedrock shales and sandstones break down into a material that is sticky when wet and very hard when dry. This severely hinders plant growth and agricultural operations. Above the bedrock lie glacial deposits which are usually free of the most adverse properties of the bedrock though they lack the plant nutrients and organic matter characteristic of the overlying topsoil.

Rebuilding a soil profile is one of the major problems in cropland reclamation in Alberta. A soil must be built on levelled overburden which will be as productive as the original soil. Existing evidence indicates that placing topsoil and a buffering material over the spoil is the most efficient method for achieving this goal (Figure 1). However, we do not know exactly how much capping material is needed in order to bring back the original level of agricultural capability. Also, where topsoils or subsoils are in short supply other amendments may be useful in soil building. In addition to soil reconstruction, certain agricultural practices like green manuring and legume cropping may help rebuild the soil.

In many plains areas the coal seams are the major source of domestic water. What will happen when the coal is removed and overburden fills the mined-out pit? The behavior of the post-mining groundwater system will affect water users and could influence future agricultural potential. However, prior to the

FIGURE 1 - GENERALIZED PROFILES



Reclamation Research Program little was known about the effects of surface mining on groundwater in Alberta.

Mining on Agricultural Land

Cropland is surface mined in two major zones in Alberta: **The Ardley Zone** running southeast from Mayerthorpe to Red Deer and the **Horseshoe Canyon Zone** which runs parallel and to the east from Barrhead through Camrose to Drumheller. The Ardley Zone is surface mined near Lake Wabamun to provide coal to the Wabamun, Sundance and Keephills power plants. An additional power plant, Genessee, is presently under construction and will extend mining southward to the town of Genessee. The Horseshoe Canyon Zone is mined on either side of the Battle River between Forestburg and Halkirk. These mines supply the Battle River Generating Station. Another power plant and mine have been developed to the south at Sheerness. (Figure 2).

Approach

Mining in the Ardley and Horseshoe Canyon Coal Zones involves two different sets of soils, overburden and climate. Also, soil reconstruction and groundwater cannot be studied in isolation. For example, if after mining a saline watertable re-establishes within a foot of the soil surface the topsoil, regardless of it's original quality, will quickly become unsuitable for crops. So in both the Ardley and Horseshoe Canyon zones we are identifying the best methods of reconstructing soils and at the same time we are studying what happens to the groundwater after mining. Table I summarizes our priorities and research activities in the Plains.

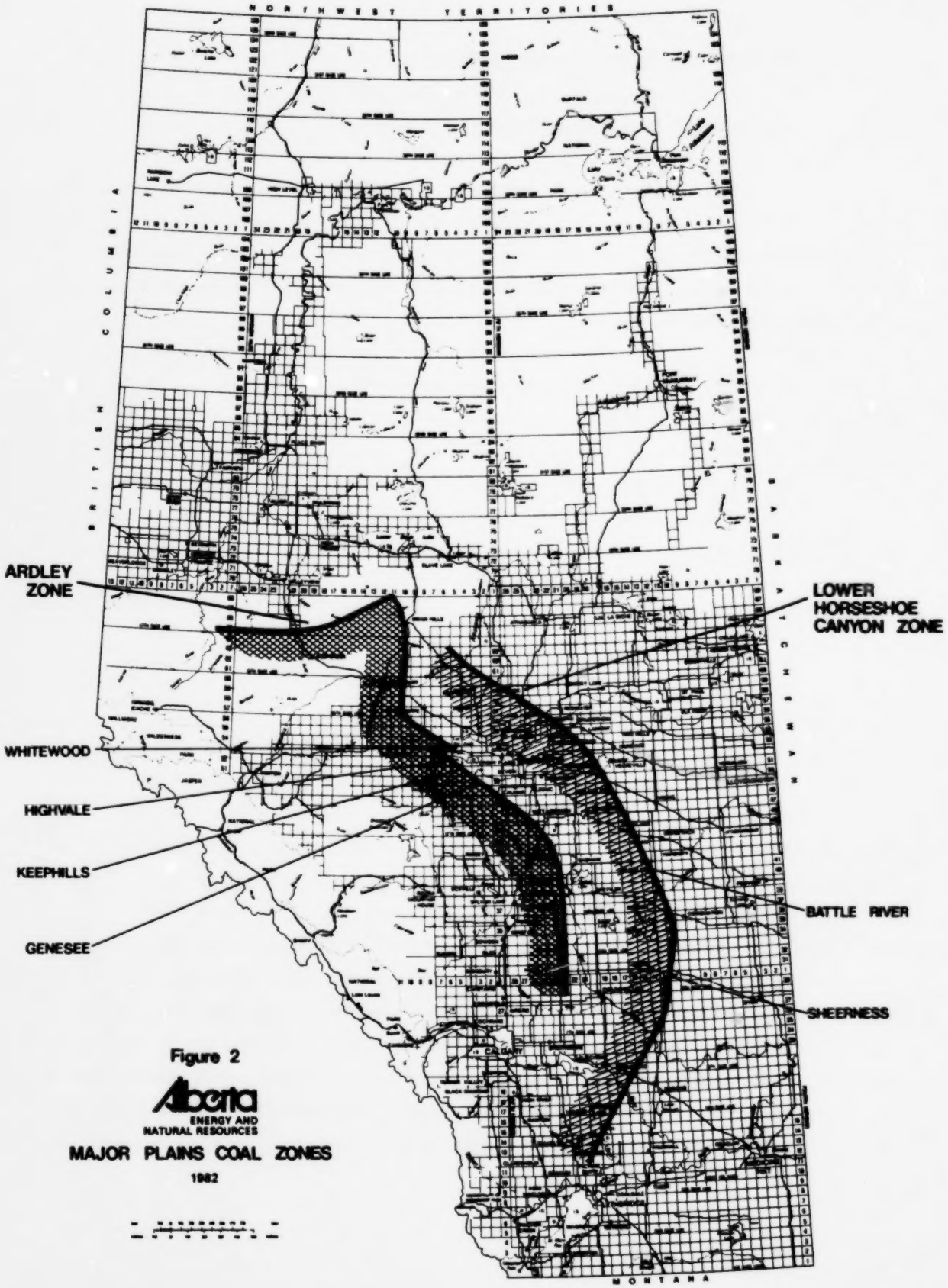


Figure 2

Alberta
ENERGY AND NATURAL RESOURCES

MAJOR PLAINS COAL ZONES

1982

A) RECLAMATION OF COAL MINED LAND

Plains Coal Reclamation Research Program

The Plains Coal Reclamation Research Program (PCRRP) has been designed by the Provincial Government and members of the Coal Industry to answer questions relating to groundwater and soil reconstruction in both of our Plains Coal Mining Zones. Two main projects have been established:

1) **The Plains Soil Reconstruction Project** will tell us how to rebuild agricultural soils after mining and

2) **The Plains Hydrology and Reclamation Project** will describe what happens to groundwater during mining and after reclamation and how to rebuild the landscape to maximize the agricultural potential.

By combining the results of these experiments we will develop a picture of how mined landscapes work and how they can be designed to ensure the return of their original values.

These projects are installed both at the Highvale and Battle River mining areas. Both are designed for five years of intensive study with the possibility for further monitoring beyond that period.

The program has been jointly designed and managed by Provincial Government and Coal Industry personnel. The projects are also funded by both Industry and Government. For example, Alberta Power Ltd., Luscar Ltd., Manalta Coal Ltd. and TransAlta Utilities Ltd. constructed the Test Plots at Battle River and Highvale while research and maintenance activities for the Soil Reconstruction and Hydrology Programs are supported by the Provincial Government.

1. Battle River Soil Reconstruction Project (82-5-LES)
   L.A. Leskiw, Pedology Consultants Ltd.

2. Highvale Soil Reconstruction Project (82-13-SCH)
   L.A. Panek, Monenco Consultants Ltd.

Grain and forage yields are being evaluated on a series of soil reconstruction plots at the Battle River and Highvale Mining Areas. Treatments include: depth of subsoil (0 to 3m thicknesses) over sodic spoil, use of bottom ash and gypsum as amendments to sodic spoil, and reconstruction of solonetzic soils. Salt movement over spoil slopes is also being studied. The project began in 1979 at Battle River and construction was complete at Highvale in 1982. (See Figures 3, 4)

Status: Cropping and Soil Sampling began at Battle River in 1982 and we now have five crop years of data. The first crop was grown at Highvale in 1983. Each site will be studied intensively for at least five years.

3. Plains Hydrology and Reclamation Project (79-2-MOR)
   S.R. Moran, Alberta Research Council

This study examines the impacts of surface mining on the regional groundwater, geology and soils. The main objectives include the identification of: 1) changes in groundwater quality and quantity after mining, 2) sources and release rates of groundwater contaminants (mainly salts), 3) changes in distribution of groundwater after mining (will the groundwater carry salts to the surface, will the watertable drop or will it re-establish at premining levels) and 4) surface stability after mining (subsidence, piping).

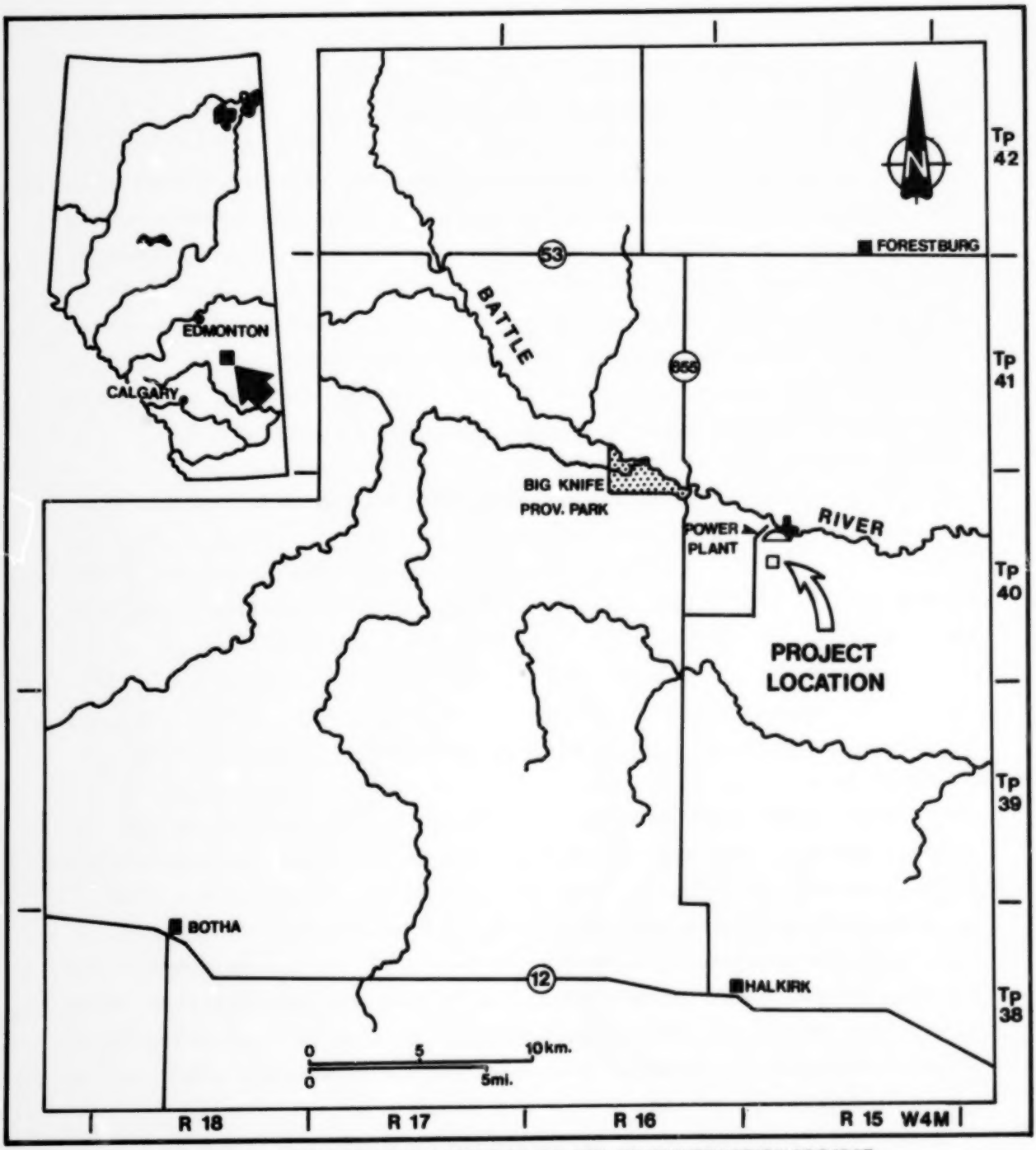


FIGURE 3a. LOCATION MAP, BATTLE RIVER SOIL RECONSTRUCTION PROJECT

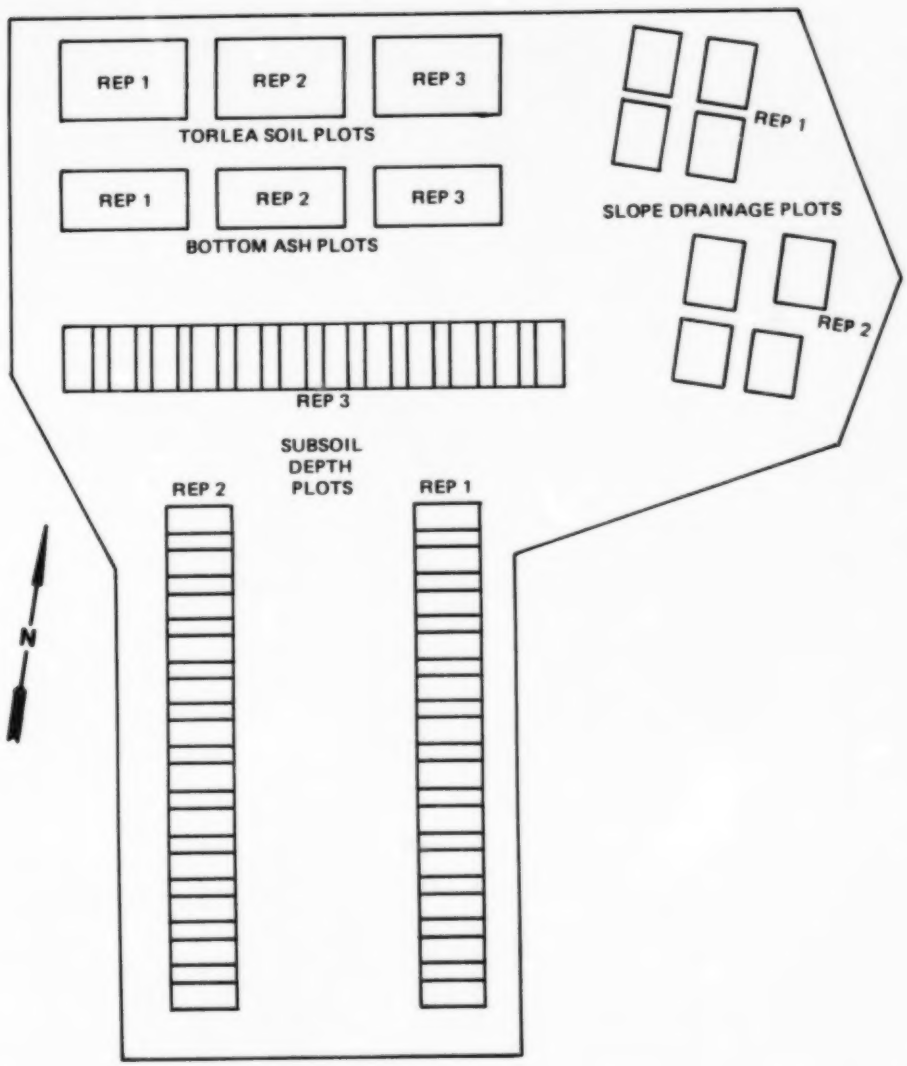


FIGURE 3b COMPOUND LAYOUT, BATTLE RIVER SOIL RECONSTRUCTION PROJECT

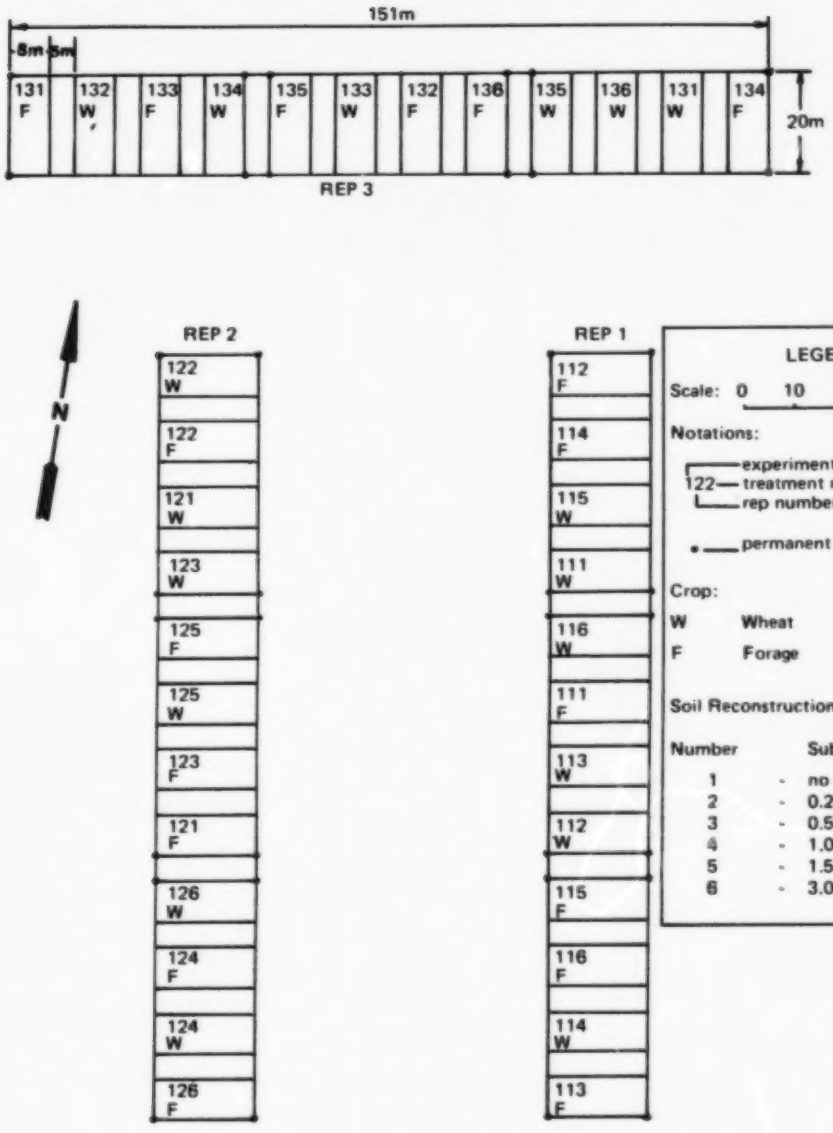


FIGURE 3c. PLOT LAYOUT – SUBSOIL DEPTH EXPERIMENT, BATTLE RIVER SOIL RECONSTRUCTION PROJECT

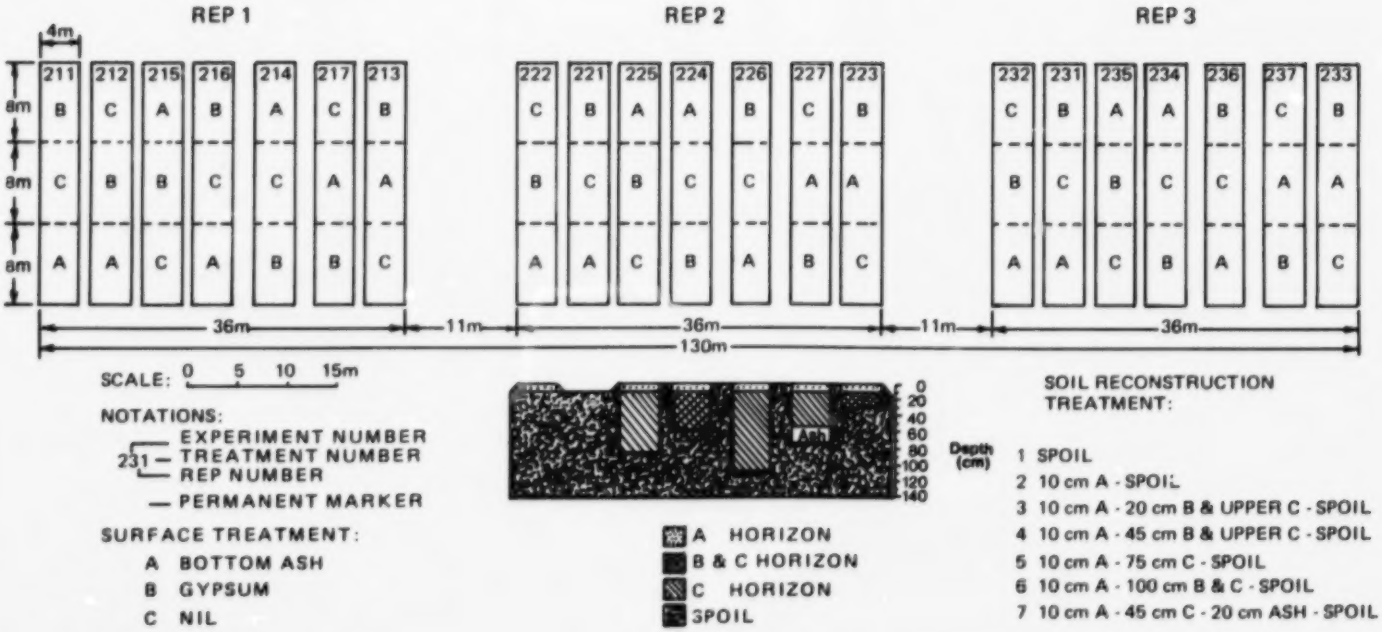


FIGURE 3d. PLOT LAYOUT – TORLEA SOIL EXPERIMENT, BATTLE RIVER SOIL RECONSTRUCTION PROJECT

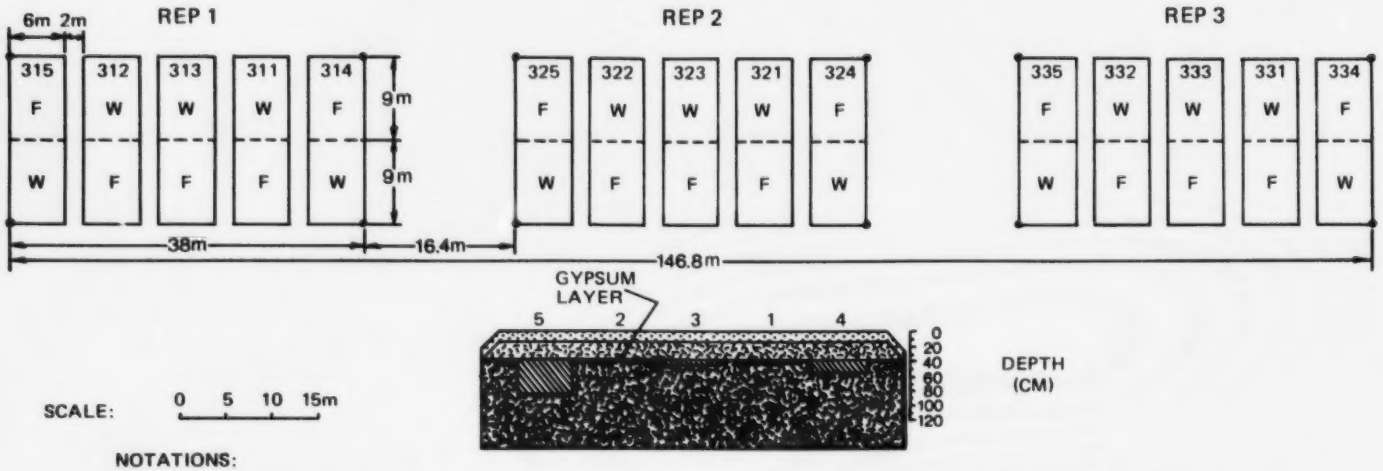


FIGURE 3e. PLOT LAYOUT – BOTTOM ASH EXPERIMENT, BATTLE RIVER SOIL RECONSTRUCTION PROJECT

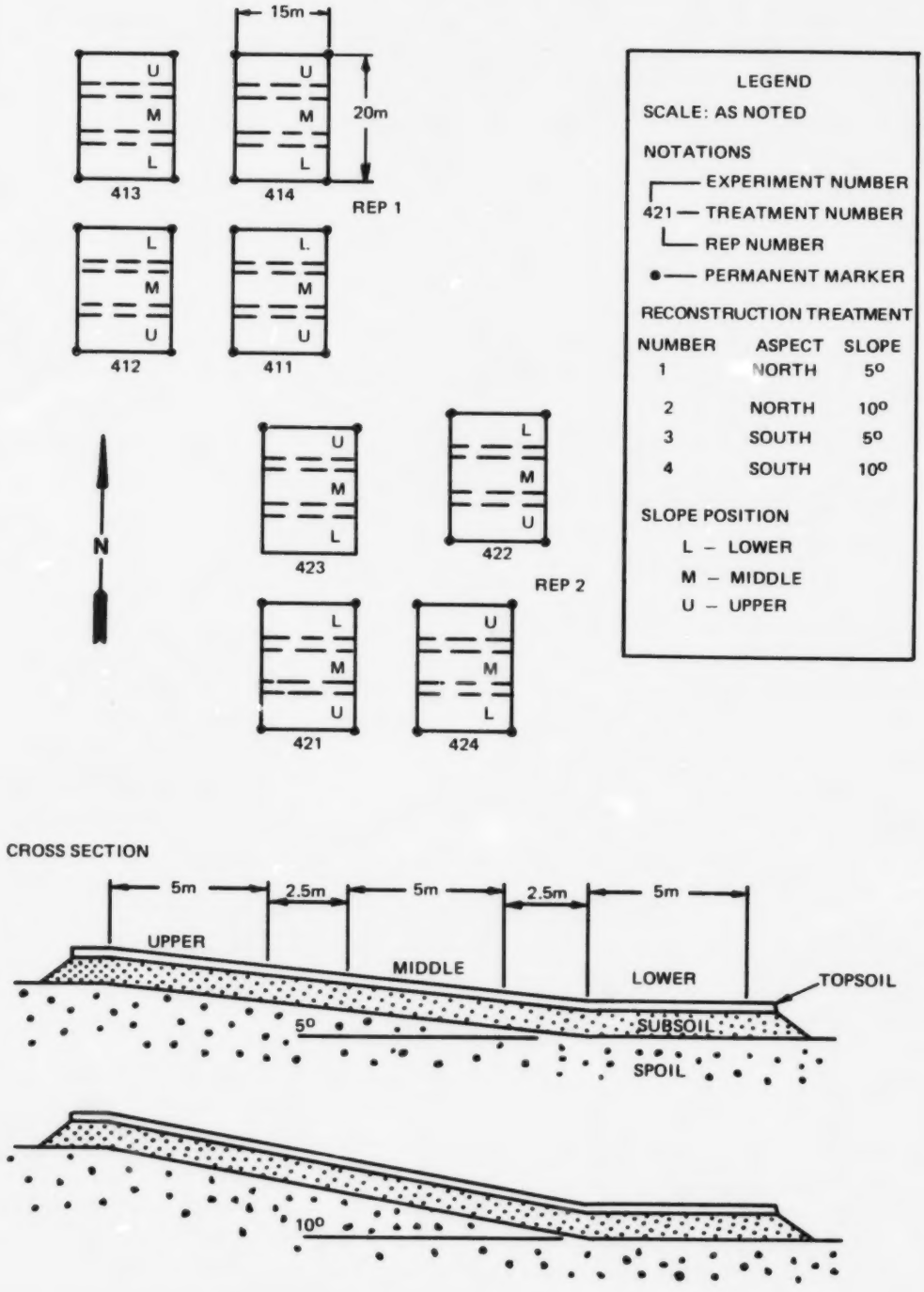
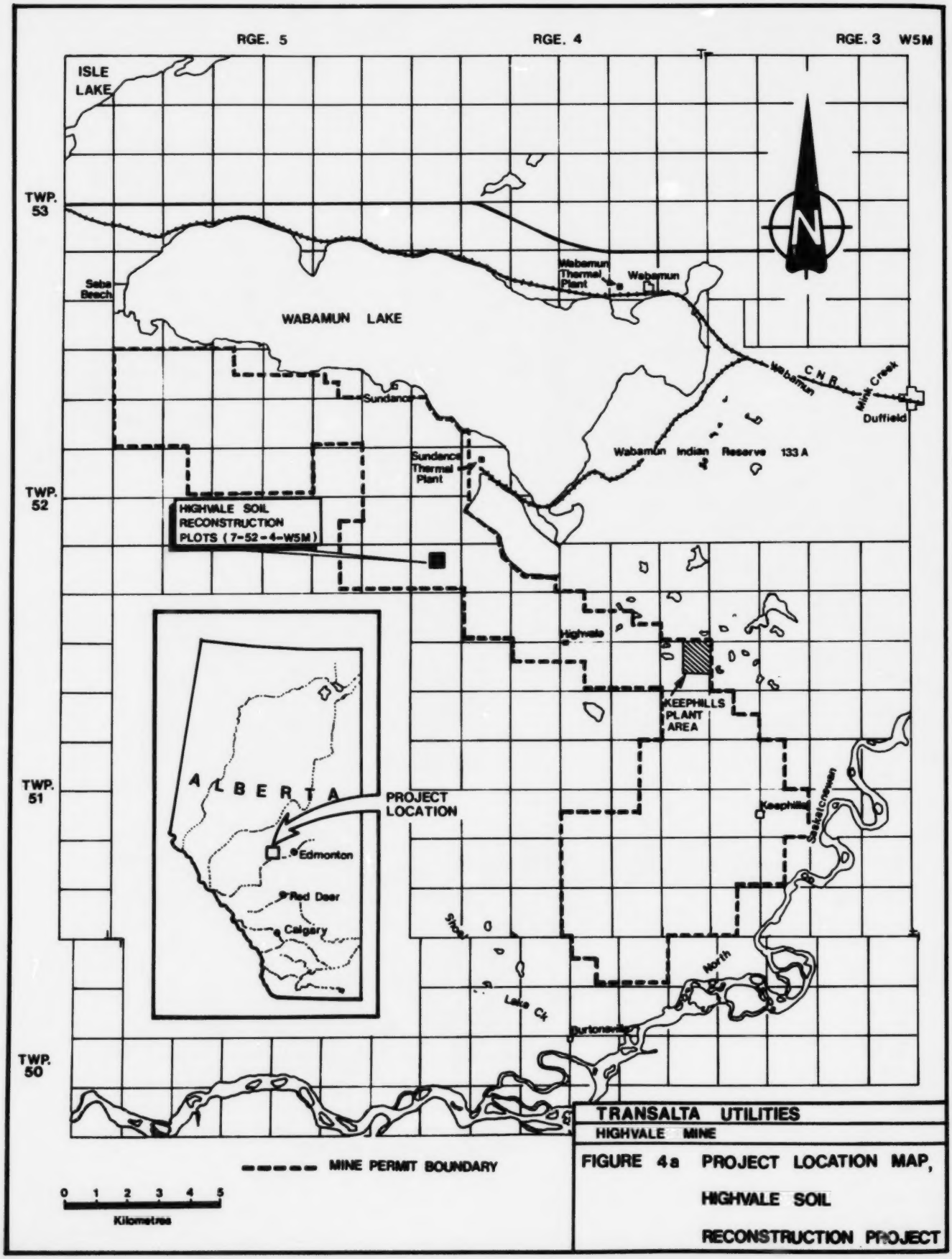
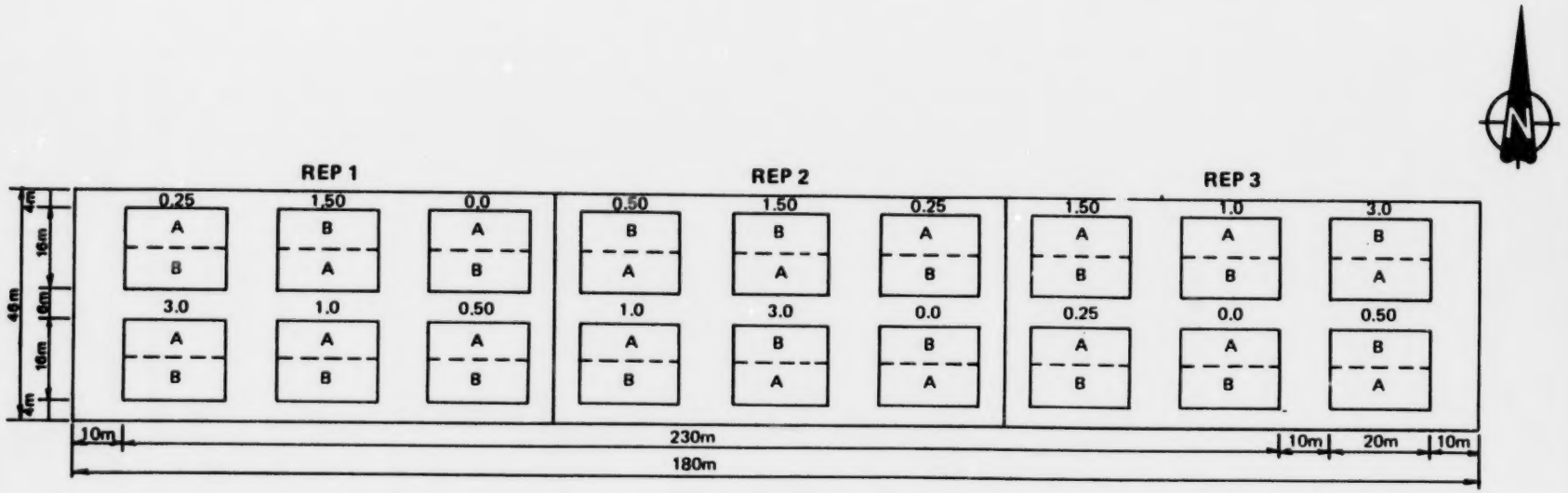


FIGURE 3f. PLOT LAYOUT – SLOPE DRAINAGE EXPERIMENT, BATTLE RIVER SOIL RECONSTRUCTION PROJECT


RGE. 5
RGE. 4
RGE. 3 W5M
ISLE LAKE
TWP. 53
TWP. 52
TWP. 51
TWP. 50
Seba Beach
WABAMUN LAKE
Wabamun Thermal Plant
Wabamun
N
C N R
Wabamun
Mink Creek
Duffield
Sundance
Sundance Thermal Plant
Wabamun Indian Reserve 133 A
HIGHVALE SOIL RECONSTRUCTION PLOTS (7-52-4-W5M)
Highvale
KEEPHILLS PLANT AREA
ALBERTA
PROJECT LOCATION
Edmonton
Red Deer
Calgary
Keephills
Saskatchewan
North
Lake Ck
Burtonsville
MINE PERMIT BOUNDARY
0 1 2 3 4 5
Kilometres
TRANSALTA UTILITIES
HIGHVALE MINE
FIGURE 4a PROJECT LOCATION MAP, HIGHVALE SOIL RECONSTRUCTION PROJECT



A - ALFALFA (RAMBLER) AND BROMEGRASS (CHARLTON)
B - BARLEY (KLONDIKE)
0.0 NO SUBSOIL
0.25 0.25m SUBSOIL
0.50 0.50m SUBSOIL
1.00 1.00m SUBSOIL
1.50 1.50m SUBSOIL
3.00 3.00m SUBSOIL

FUGURE 4b.

HIGHVALE SOIL RECONSTRUCTION PROJECT

SUBSOIL EXPERIMENT LAYOUT

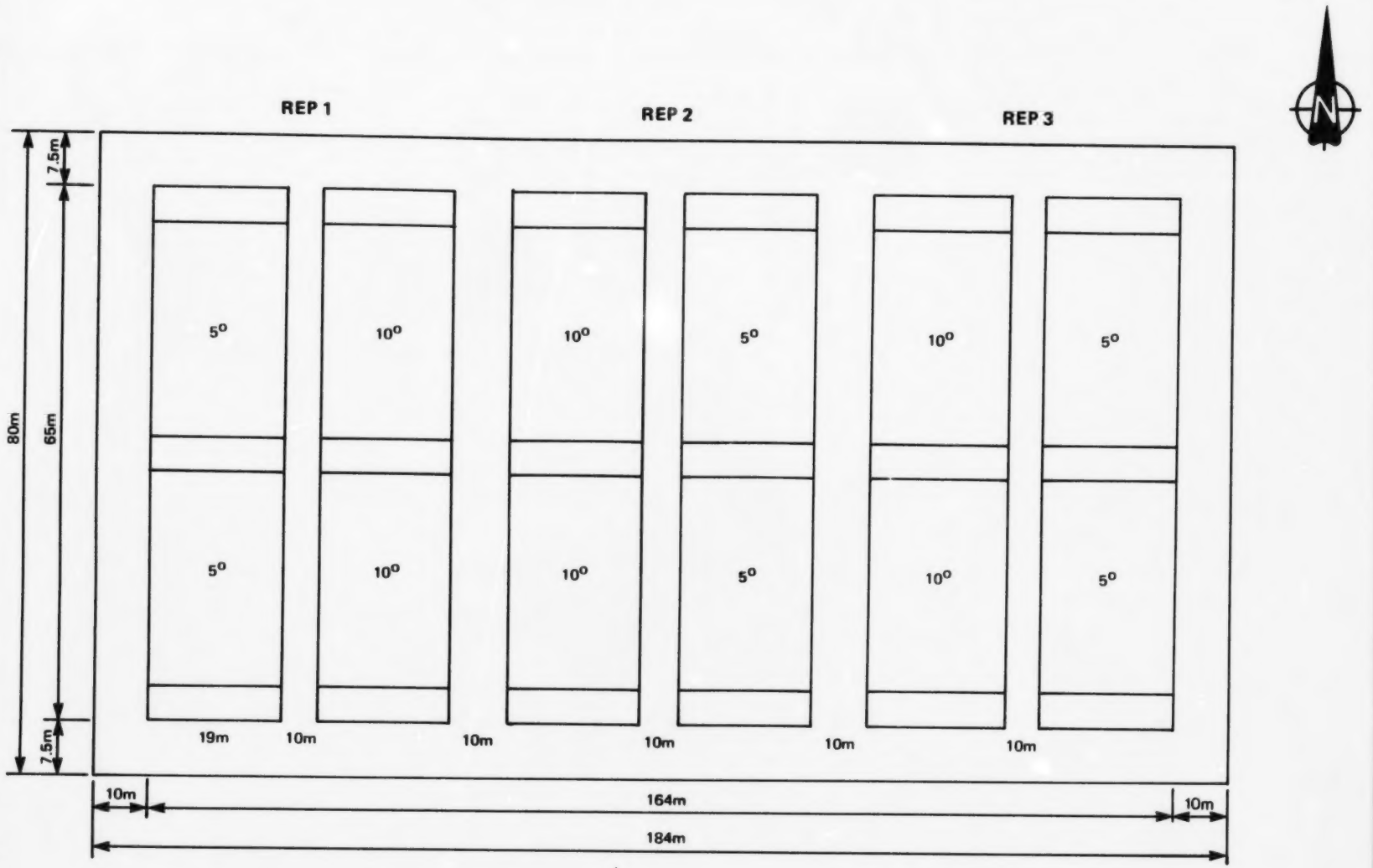


FIGURE 4c.

HIGHVALE SOIL RECONSTRUCTION PROJECT

SLOPE EXPERIMENT

LAYOUT

(NOT TO SCALE)

FORAGE CROP

Critical groundwater and geologic parameters will be identified which should allow us to predict the "reclamability" of a site prior to mining. This project began in 1979 and, like the Plains Soil Reconstruction Project, it is duplicated at the Battle River and Highvale Sites.

Status: Phase 1

During 1979-80, the first year of the five year Phase 1, instrumentation to collect basic data on the geology, subsurface water, and soils of the Battle River mining area was installed. Mapping of the soil and geology and a program of testhole drilling were also included in the initial phase of premining site characterization. In spite of a late start during the first year, most of the instrumentation that was planned was installed but virtually no data could be collected.

During the second year (1980-81) approximately 90 percent of the instrumentation needed to characterize the Battle River site was completed. Monitoring programs that were begun in the very late stages of 1979-80 were continued throughout 1980-81. A considerable body of data on properties of overburden materials and chemistry and movement of subsurface water was accumulated by the end of 1980-81. In addition, experimental studies were initiated to describe the total salt yielding properties of various types of overburden materials under a range of conditions of water content and oxygen access.

During 1981-82, experimental studies on physical and chemical weathering of overburden materials at the Battle River site were carried out. Various physical and chemical properties of the overburden, such as grain size and mineralogy, were determined and were related to weathering characteristics. Field studies were essentially completed to define hydrologic conditions at the Battle River site.

Unanticipated complexities in flow patterns in spoil at Diplomat Mine, combined with problems with experimental techniques used to measure infiltration in spoil required further work on spoil hydrology at that site. Significant progress was made in the computer modeling of mine-affected groundwater-flow systems. Study of post-mining groundwater supply potential was nearly completed and generalizable conclusions began. Preliminary synthesis of project data into a two component predictive model was possible. A group of hydrologic parameters that will permit projection of post-mining water-table configuration was identified and evaluation of their interactions had advanced well. The chemical component of the model had not advanced as far but the basic elements were identified.

During 1982-83, evaluation of a second site, the Highvale site, began with the installation of hydrologic monitoring instrumentation. Major effort focused on evaluation of hydrogeology and chemistry of mine spoil at both the Highvale and the Whitewood Mine. In addition, the existing network of wells installed by TransAlta Utilities to monitor groundwater in the unmined area adjacent to the Highvale Mine was expanded. A series of sites to monitor water movement in the unsaturated zone was installed. Initial study of the weathering characteristics of overburden was begun.

At the Battle River site, new instrumentation was installed to refine our understanding of spoil hydrology and the flow of groundwater from the spoil into adjacent aquifers. Infiltration tests were successfully completed in the spoil and improved techniques of analysis greatly increased the amount of data that was derived from these and preceding tests. These data combined with groundwater

data improved our understanding of groundwater recharge in the area. Overburden weathering studies were completed and a preliminary procedure to relate weathering data to groundwater chemistry in spoil was developed. Groundwater-flow modeling provided some significant insight into the spoil resaturation process. Settlement of interridge areas following grading appears to facilitate infiltration of surface water, which promotes further settlement.

The fifth year of the study (1983-84) served as a period of refinement of the predictive framework developed at the Battle River site. At the Highvale Mine site, instrumentation was completed and field scale experiments installed at both sites to test the validity of the overall predictive framework on salt yield of the overburden.

Status: Phase II

The second phase of the project, which has a scheduled duration of three years, began in 1984-85. The objectives of the second phase of study were reformulated from the objectives of Phase I to reflect the knowledge gaps identified in Phase I. The three subobjectives of this second phase focus on (1) design and construction of reclaimed landscapes that maximize long-term agricultural capability by minimizing potential salinization through the management of water in the landscape; (2) assessing changes in agricultural capability and productivity of reclaimed landscapes on a long-term basis; and (3) refining our understanding of groundwater chemistry and recharge in reclaimed landscapes, as well as groundwater-induced salinization effects adjacent to reclaimed areas.

Work during 1984-85 has focused on installation of intensive instrumentation in a number of slope and depressional settings in reclaimed and analogous unmined sites, primarily in the three mines at the Battle River site. Only preliminary data have been accumulated from this new instrumentation.

Work planned in 1985-86 will complete the planned instrumentation early in the year and then concentrate on monitoring. Considerable work is planned to further the synthesis of data accumulated during the year and to incorporate these data into interpretive models developed as part of Phase I.

In 1986-87, data collection will continue, but the major activities will focus on re-synthesis of models of infiltration and groundwater recharge, salt and water movement, and surface stability in reclaimed landscapes. It is hoped that firm recommendations on design parameters for reclaimed landscapes will be possible at the end of this second phase of the study. This phase of study will also develop recommendations to the government and industry for long-term data collection and synthesis activities that are necessary to monitor the performance of the models developed by the project to assure that the reclaimed landscape is functioning as intended.

Results: Reports # RRTAC 86-2
RRTAC 86-3
RRTAC 86-4
RRTAC 86-5
RRTAC 86-6
RRTAC 86-7

4. Physical and Chemical changes in Stockpiled Topsoil (79-26-FUJ)
J. Fujikawa, Technical Development Branch, Alberta Environment

A topsoil stockpile near Bow City, Alberta, had been monitored along with undisturbed topsoil to determine whether adverse changes occur during storage. Ultimately this line of research will indicate how long topsoil can be stored before deterioration occurs.

Status: Completed

Results: Final Report 79-26-FUJ. No significant adverse changes were measured during three years of monitoring.

5. Contribution of Groundwater Organic Compounds to Salinization In Plains Surface Mining (79-22-HOD, 79-27-HOD)
G.W. Hodgson, University of Calgary

These projects examined the organic chemistry and microbiology of mine spoil weathering and were instituted to complement the inorganic chemistry approach taken in the Plains Hydrology Reclamation Project.

Status: Completed

Results: Report # RRTAC 80-3

B) FLY & BOTTOM ASH DISPOSAL

Three studies were conducted to characterize Alberta Coal Ashes and to assess their effects on soils and crops.

6. Chemical Characteristics of Bottom Ash and Fly Ash From Four Alberta Power Stations (78-2-MCC)
D. McCoy, Technical Development Branch, Alberta Environment

7. Plant Nutrient-Agronomic Potential of Coal Ash (78-20-MCC)
D. McCoy, Technical Development Branch, Alberta Environment

8. Physical and Chemical Characterization of Fly Ash (78-5-P/R)
D. Pluth, J. Robertson, Soils Dept., University of Alberta

Ash samples were collected over a period of time and analysed to determine if fly and bottom ash chemistry varied among various coal seams and power plants, and whether ash from a given source varies significantly through time. Various rates of fly ash and bottom ash were mixed with two soils and a sodic spoil to determine whether ash addition can enhance growth of barley and alfalfa. Fly Ash from five sources around Alberta were surveyed for physical and chemical properties. Plant toxicities were evaluated in greenhouse studies.

Status: Completed

Results: Report # RRTAC 81-3

9. Use of Bottom Ash as an Amendment to Sodic Spoil (83-4-LAN)
S. Landsburg, Alberta Environment

Prior to the current practice of soil salvage and replacement surface mined land in the Plains generally reverted to waste land. This was particularly true where sodic overburden was encountered. Reclamation of these orphaned areas in the absence of suitable soil requires amendment of the sodic spoil surface. Perhaps the most promising amendment appears to be bottom ash from the nearby power plants. Earlier research indicated that this waste product possesses the ability to significantly improve sodic spoil. this project will identify, through field testing, which ash amendment rates and incorporation methods are most effective in developing at least minimal productive potential in orphaned sodic spoil.

Status: Completed

Results: Final Report 83-4-LAN

c) OIL & GAS DISTURBANCES

10. Evaluation of Pipeline Reclamation Practices on Agricultural Land (81-1-HAS)
W.J. Hastie, Hardy Associates (1978) Ltd.

This study addressed the effects of construction and reclamation of three pipeline sizes: 56", 36" and 10". A description of the major types of pipeline construction and reclamation techniques was prepared and their difference relative to surface disturbance noted for various soil zones, types and agricultural land uses.

Status: Completed
Results: Report # RRTAC 83-3

11. Disposal of KCl Drilling Muds, (85-9-LLO)
L. Leskiw, Pedology Consultants

This literature review evaluated options for drilling fluid disposal and indicated associated effects on Soils and Vegetation. Most primary disposal methods were identified and a filed manual of disposal methods was developed. Areas regarding further research were identified. A technical review of existing guidelines was also conducted.

Status: Completed
Results: Final Report 85-9-LLO

II. MOUNTAINS AND FOOTHILLS

Reclamation Objectives

1) Control of erosion on a wide variety of disturbances including coal mines, mineral exploration sites, coal ash pits and oil and gas well sites.

2) Return of forested lands to previous levels of productivity.

3) Return of wildlife range to previous levels of productivity.

The Problem

Reclamationists in the mountains and foothills face a wide variety of conditions. While some foothill sites are characterized by subdued terain and moderate climate other sites, particularly in the mountains, present steep slopes, rocky spoil and a short growing season. On these problem sites summer droughts, chinook winds, erodible slopes and nutrient-poor soils are common.

On lower elevation foothill sites reclamation is expected to yield forests with commercial potential while on the higher elevation mountain sites erosion control, development of wildlife habitat and recreation potential are the reclamation objectives.

Reclaimed land in the mountains and foothills will not be as intensively managed as reclaimed agricultural lands would be. Also, topsoils and subsoil layers tend to be thin and difficult to handle selectively. They nonetheless are a valuable source of plant nutrients. So while some mixing of horizons is inevitable how much is acceptable? How thick should the replaced soil layer be? Other sites simply have no salvageable topsoil and reclamation must prepare the site so that a plant-soil system will develop which will perform its land use expectations without indefinite fertilization.

In 1984 the Coal Association of Canada and RRTAC initiated the jointly-funded Mountain and Foothills Reclamation Research Program (MFRRP). The program's initial objectives focus on Water Management, Soil Reconstruction, Reforestation and Wildlife Habitat Development. Projects 2, 3, 17 and 18 represent the first two year's activities in MFRRP.

Table 2 indicates our priorities and program summary in the Mountains and Foothills.

A) LANDSCAPE DESIGN

One of the most important aspects of Reclamation in the Mountains and Foothills is creation of stable reclaimable landscapes. This includes dump design (optimal slope angles and lengths, terracing) and pit backfilling. Another critical aspect of landscape design involves the creation of new water-sheds. These must be designed to control water flows and siltation of surrounding waters.

1. Mountain and Foothill Dump Design (82-14-CHO)

R.G. Chopiuk, Coal Mining Research Center

In Phase 1 resloped overburden dumps in Alberta and British Columbia were surveyed to identify practical construciton and resloping strategies. It was found that many though not all dumps were graded to shallower slopes (22-24°) than had been designed (27°). Operator and machine limitations were cited.

In Phase II a number of slopes were instrumented to identify the volumes of erosional loss due to various slope angles, lengths, berms and topsoiling.

Status: Completed

Results: Final Report 82-14-CHO

2. Analysis of Settling Pond Design and Alternative Technologies (84-12-MON)

A.H. Somani, Monenco Consultants Ltd.

Methods for design and construction of settling ponds were evaluated with respect to Mountain and Foothill conditions. Also, alternatives to settling ponds were assessed.

Status: Completed

Results: Report #RRTAC 86-1

B) SOIL RECONSTRUCTION

Soil Reconstruction in the Mountains and Foothills involves making the best use of limited soil materials. The objective is to improve the Root Zone over Rocky and Nutrient-Poor Spoils. At Grande Cache coal ash disposal sites must be revegetated with implications for building a soil on the ash surface.

Of particular interest is the reinstatement of commercial forest capability on mined land. Three test plots have been established in the Foothills by Luscar Ltd., Union Oil of Canada Ltd. and Crows Nest Resources Ltd. which compare various thicknesses and blends of soil materials for commercial tree growth. These projects were developed in consultation with RRTAC and are supported entirely by company funds.

Several projects conducted by the Reforestation & Reclamation Branch of the Alberta Forest Service have met their initial objectives. The results are published in Report # RRTAC 85-1. These plots remain available should additional monitoring intervals be required.

3. Soil Reconstruction in Mountain and Foothill Coal Mining (84-23-PED)

L. Knapik, Pedocan Land Evaluation Ltd.

This review assembled available information to facilitate operational reclamation decisions to provide for tree growth (forestry use), shrub growth (wildlife habitat) and herbaceous cover (erosion control). This review also identified information gaps and recommended needed research.

Status: Ongoing.

4. Revegetation of Ash Disposal Sites, Grande Cache (79-1-MAC)

T.M. Macyk, Alberta Research Council

This project identified the thickness of capping material over coal ash required to support an erosion-controlling cover crop. This was a co-operative project with McIntyre Mines Ltd.

Status: Completed

Results: Final Report 79-1-MAC. With thirty cm of capping soil (overburden) good plant growth and cover were observed. Increasing depths of capping soil gave no increase in yields.

C) REVEGETATION

Reclamation programs may have several objectives in the Mountains and Foothills including development of forestry capability, wildlife habitat and watershed values. Our objective is to develop revegetation methods which will meet objectives without long-term maintenance. Within the revegetation problem area priorities have been identified for herbaceous cover (species selection, erosion control, fertilization, nutrients) and for shrub and tree cover (propagation, establishment).

SPECIES SELECTION

5. Selection of Native Grasses for Reclamation (79-7-WEI)
R. Hermesh, Alberta Environment Centre

Many alpine and subalpine sites are difficult to reclaim simply because commercially available grasses and legumes either cannot survive or reproduce in the short growing season. This study is selecting lines of native grasses which are known to invade disturbances in the subalpine and alpine. Selections are made on the basis of commercial potential and fitness for reclamation.

Status: Ongoing

Results: Three lines of Agropyron species are presently undergoing testing for licencing application with the Canadian Department of Agriculture.

6. Native Grasses for Reclamation: Selected Line Adaptability Trials (79-23-WEI)
P.F. Ziemkiewicz, Alberta Energy and Natural Resources

By early 1979 the above study had produced nine selected lines of native grass species. To ensure that the selected lines had not lost their tolerance to high-elevation conditions in the process of development, a series of test plots was established: 1) to evaluate their fitness to subalpine and alpine conditions, 2) to compare their performance against selected agronomic grasses and 3) to evaluate their respective fertilizer requirements.

Status: Completed

Results: Report # RRTAC 85-1

7. Evaluation of Native-Agronomic Grass/Legume Mices for Reclamation of Subalpine Disturbances (78-18-RUS)
H. Tomm, Alberta Forest Service

Certain agronomic grasses and legumes are known to quickly establish an erosion-controlling cover while native grasses generally grow more slowly. This experiment tests which of several native/agonomic seed mixes provides the best combination of erosion-control and long-term stability.

Status: Completed
Results: Report # RRTAC 85-1

8. Survey of Alberta Forest Service Native Grass Trials (82-12-TOM)
M. Mihajlovich

Between 1975 and 1977 a number of Test Plots were established in the Mountains and Foothills from Alpine to Boreal Forest conditions. Native Grass, Tree and Shrub container plantings were tested as well as various topsoiling treatments. Other treatments included island transplants and various agronomic legumes. This study was undertaken in 1982 to: 1) Document the location of the Plots and 2) gather and synthesize all available information.

Status: Completed
Results: Report #RRTAC 85-1

EROSION CONTROL

9. Methods for Establishing Grass Cover on Unamended Coal Spoil (80-11-TAK, 79-17-TAK)
S.K. Takyi, Alberta Forest Service

This study compares different seeding methods for native grass mixes (hydroseeding, broadcasting and raking, simulated drilling). Also various erosion-controlling mats, mulches and contouring treatments are evaluated.

Status: Completed
Results: Report # RRTAC 85-1

10. Survey of Alberta Forest Service Reclamation Sites (78-1-LAR)
G. LaRoi, University of Alberta, Forest Science Department

Reclamation roads and drilling sites were surveyed in 1978 to assess revegetation success 4 to 7 years after treatment. Permanent sampling plots were established which may be reassessed in the future to better understand plant succession on reclaimed sites.

Status: Completed
Results: Final Report 78-1-LAR

FERTILIZATION, NUTRIENTS

11. Factors which Accelerate Development of Stable Nutrient Cycles (82-11-Z/T)

P.F. Ziemkiewicz, S.K. Takyi,
Alberta Energy & Natural Resources

The effects of topsoiling, Species Selection (Native vs Agronomic, Grass vs Legume) and Maintenance Fertilizer Regime are evaluated on a Subalpine Coal Mine with regard to plant development, distribution, uptake and cycling of nutrients.

Status: Completed

Results: Report #RRTAC 85-1

12. Survey to Determine the Occurrence of Microbial N-fixing Root Sheaths (79-8-L/R)

M.J. Rowell, Norwest Soil Ltd.

Preliminary work suggested that root sheaths may be a significant source of N-fixation for grasses growing in nutrient-poor soils. This survey was commissioned to look for root sheath occurrence on reclaimed and undisturbed areas. Correlations were made between plant vigor and root sheath occurence. N-fixing rhizosheaths were found on grasses growing on disturbed sites more commonly than on undisturbed sites. Future work may involve isolation and identification of the N-fixing organisms. When available, the resulting inocula would be tested under field conditions to determine whether they have value as a reclamation treatment.

Status: Completed

Results: Final Report 78-8-L/R

13. Uptake of Nitrogen by Native Grasses (78-3-M/P)
D. Paton, University of Alberta

It is often assumed that native grasses require less nutrient than their agronomic counterparts. This study compared the nitrogen uptake rates of native and agronomic grasses to learn more aobut their nutrient requirements.

Status: Completed
Results: Final Report 78-3-M/P

14. Native Shrub Seed Propagation Testing Project (80-16-KIN)
P. King, Alberta Forest Service

Methods for collecting, handling and treating seed of native shrub species with potential for reclamation will be evaluated to maximize propagation success.

Status: Completed
Results: Report # RRTAC 85-1

15. Factors Affecting Germination of Buffaloberry (82-1-K/H)
C. Keating, University of Alberta, Forestry Department

Buffaloberry (Shepherdia canadensis) is a valuable shrub for Reclamation, but it is difficult to propagate. This Study investigated methods for enhancing germination of Buffaloberry seed so that stock may be produced in large quantities for Mine Reclamation

Status: Completed
Results: Final Report 81-1-K/H

TREE & SHRUB ESTABLISHMENT

16. Optimization of Erosion Control and Reforestation Potential of Reclaimed Areas (79-16-MIH)
P. King, Alberta Forest Service

This study will identify the level of grass/legume cover which will prevent erosion yet permit tree seedling growth. This study will also identify methods for predicting the optimal levels of herbaceous cover.

Status: Ongoing
Results: Report # RRTAC 85-1

17. Growth Performance of Commercial Timber Species in Reclamation (84-28-DEM)
W.R. Dempster and Associates Ltd.

The purpose of this study was to review and report, from available literature, growth performance data that could be used to develop standards expected of commercial timber species for reclaimed lands in the Eastern Slopes of Alberta.

Study Parameters included:

1. Rates of juvenile growth, and appropriate measurement techniques and timing, required to provide reasonable assurance of successful reclamation;

2. The impact of site and cultural factors on growth performance, and the extent to which growth can be predicted form these factors;

3. Recommendations for the development of growth performance standards or guidelines including growth rate expectations, assessment methodology, the length of time required to assess performance, and the extent and acceptability of management inputs;

4. Further research required to assist in the formation of growth standards and guidelines.

Status: Ongoing

18. Reclamation for Wildlife Habitat in The Mountains and Foothills of Alberta (84-18-LGL)
J.E. Green, LGL Ltd.

This Study addressed: the synthesis of current information on habitat requirements of major wildlife species in the Mountains and Foothills of Alberta, an evaluation and collation of information on reclamation procedures for wildlife habitat, the applicability of these methods to Alberta, and the development of criteria for the assessment of wildlife habitat reclamation procedures for certificastion purposes.

Status: Ongoing

III. NORTHEAST ALBERTA

Reclamation Objectives

1) To develop techniques whereby a self-sustaining, erosion-free cover can be established on oil sand tailings pond dykes.

2) To return tailings sand storage and overburden dumps to productive forest.

The Problem

Northeast Alberta contains all of Canada's surface-mineable oil sands. Extraction of this valuable petroleum resource presents several problems for reclamation. By far the greatest problem lies with the tailings disposal systems currently employed.

At the end of its 25 year life a typical oil sand plant producing 19 900 cubic meters per day (125 000 barrels per day) of synthetic crude oil will require a 22 to 31 square kilometer (8.5 to 12 square miles) tailing pond. The liquid contents of the pond will consist primarily of 360 million cubic meters of sludge. The sludge will remain in a liquid state indefinitely and will be impounded behind dykes built of tailings sand. Dyke heights will reach from 55 to 100 meters above ground level. Erosion protection will be provided by a cover of grasses, legumes and shrubs. Because the tailings sand is devoid of nutrients and drains rapidly, amending materials (Muskeg, certain mineral overburdens) will be added to begin development of a soil.

Pits left after mining will be filled with tailings sand and overburden dumps will be constructed. These sites will also be reclaimed to a designated land use. Soil reconstruction and woody plant establishment in particular need further research.

Approach

As in the mountains and foothills, proper reclamation in Northeast Alberta will produce landform and plant community combinations which will fulfill their land use requirements without indefinite maintenance.

In order to pool resources and avoid duplication of effort, RRTAC and the industry's Oil Sands Environmental Study Group (OSESG) initiated a joint Reclamation Research Program. Three priority areas have been identified:

1) Woody Plant Research

2) Soil Reconstruction

3) Equipment Development.

The Woody Plant Research Program is now underway and test plots for the Soil Reconstruction Research Program were constructed in 1983.

A) SOIL RECONSTRUCTION ON TAILINGS SAND

1. Soil Reconstruction Project: Phase I Literature Review (79-24-OSE)

   R. Johnson, Montreal Engineering Co. Ltd.

This joint OSESG/RRTAC project identified available soil-building materials in the Oil Sands area and proposed several combinations of these materials to form productive soils. Phase I, which was a literature review and analysis of existing information, was funded in 1979/80. The review identified treatments for the Test Plot Program which will constitute Phase II of the Soil Reconstruction Project.

Status: Completed

Results: Report # OSESG/RRTAG 83-1

2. Soil Reconstruction Project:
Phase II Field Trials (83-10-HAR)
H.E. Martens, Hardy Associates (1978) Ltd.

Field trials were established on a 7 ha pad of tailings sand prepared by Syncrude Canada Ltd. on their property north of Ft. McMurray. Various mixtures of peat and clay were incorporated to 20 and 40 cm depths. In 1984 the plots will be planted with tree and shrub species to identify the best soil prescription for a particular forest cover type.

Status: Plot construction completed, seedlings planted, two years of monitoring completed.

3. Reinstatement of Biological Activity in Reconstructed Soils (81-3-PAR)
D. Parkinson, University of Calgary

The nature of micro organism establishment on reconstructed spoils was investigated in a series of field and laboratory studies. Emphasis centered on Fungal Decomposers and Mycorrhizal Fungi and the influence of various amendments (peat, sewage sludge, inorganic fertilizers) on their populations.

Status: Completed
Results: Report # RRTAC 84-4

4. Mycorrhizal Potential in Reconstructed Soils (81-2-PAR)
D. Parkinson, University of Calgary

Mycorrhizal Fungi nearly always enhance tree nutrition. This project has determined the survival and inoculum potential of Mycorrhizal Fungi in undisturbed and stockpiled peat to be used in oil sand tailing reclamation. Also, Fungal species have been

selected for use in Jack Pine seedling inoculation. Their effect on tree growth is being monitored in field trials.

Status: Ongoing

B) REVEGETATION

Revegetation in the Oil Sands will focus on establishing shrubs, commercial and non-commercial tree species and in some areas a grass-legume cover for erosion control. The latter is readily accomplished so the Revegetation Research Program concentrates on establishment of shrubs and trees.

5. Selection of Tree and Shrub Varieties for Oil Sand Reclamation (79-13-DUN)
   S.K. Takyi, P. King, Alberta Forest Service

In 1979 a test site in the oil sands area was planted with varieties of native and exotic tree and shrub species to help select those most suitable for oil sands reclamation.

Status: Ongoing

6. Survey Establishment and Maintenance Procedures (81-4-P/F)
   R. Hermesh, Techman Engineering Ltd.

7. Review of Propagation Methods (81-5-WAT)
   R. Hermesh, Techman Engineering Ltd.

8. Seed Collection for Shrub & Tree Trials (81-6-K/K)
   D.J. Klym, Suncor INc., P. King, Alberta Forest Service

9. Review of Sampling Methods (81-7-ROW)
   M.J. Rowell, Norwest Soils Ltd.

These four Projects were preliminary to establishment of Field Trials in 1983. All were jointly supported by OSESG and RRTAC.

Status: Completed

Results: Final Reports: 81-6-K/K, 81-7-ROW
Reports #OSESG/RRTAC 83-5
OSESG/RRTAC 84-1

IV GENERAL

A number of projects will yield results applicable to reclamation problems throughout Alberta. These projects are listed below.

Projects

1. Reclamation Review (78-6-SIM)
   H.P. Sims, Alberta Environment

This project will compile information from the international reclamation literature pertinent to Alberta. The Reclamation Review will not only serve as a handbook of reclamation techniques, it will also identify gaps in our reclamation knowledge and point the way for future research. It may be accessed via the Computerized Search Guide/Bibliography and the text "Land Surface Reclamation: A Review of International Literature".

Status: Completed

Results: Reports # RRTAC 82-1
RRTAC 84-1

2. Reclamation Activities in Alberta (80-15-SIM)
H.P. Sims, Alberta Environment

Reclamation and reclamation research activity in Alberta were surveyed and presented in report form.

Status: Completed
Results: Report # RRTAC 81-2

3. Cross Reference for Reclamation Review (80-13-WAL)
D.G. Walker, David Walker Assoc. Ltd.

This project provided a cross reference of keywords, authors and subjects as part of the Reclamation Review.

Status: Completed
Results: Report # RRTAC 82-1

4. Species Suitability Manual (79-5-W/P)
L.E. Watson, Techman Ltd.

This manual catalogued available information on the many species used as useable in reclamation. This will help Reclamationists design seed mixes which are better adapted to their particular needs.

Status: Completed
Results: Report # RRTAC 80-5 Vol. I Grasses
Vol. II Forbs, Shrubs & Trees

APPENDIX

LOCATION OF FIELD PLOTS

PLAINS

1) 79–2–MOR FORESTBURG, HIGHVALE.
2) 82–5–LES FORESTBURG.
3) 82–13–SCH HIGHVALE.
4) 79–26–FUJ BOW CITY.
5) 78–4–PAR CALGARY.
6) 83–4–LAN FORESTBURG

MOUNTAINS & FOOTHILLS

1) 79–1–MAC GRANDE CACHE.
2) 79–16–MIH COALVALLEY, CROWSNEST.
3) 79–17–TAK CADOMIN.
4) 79–18–RUS CADOMIN.
5) 80–11–TAK CADOMIN.
6) 79–23–WEI CADOMIN, GRANDE CACHE.
7) 82–11–Z/T CADOMIN.
8) 82–14–CHO GRANDE CACHE, LUSCAR, CROWSNEST

NORTHEAST OIL SANDS

1) 81–2–PAR MILDRED LAKE.
2) 79–13–DUN MILDRED LAKE.
3) 83–10–HAR MILDRED LAKE

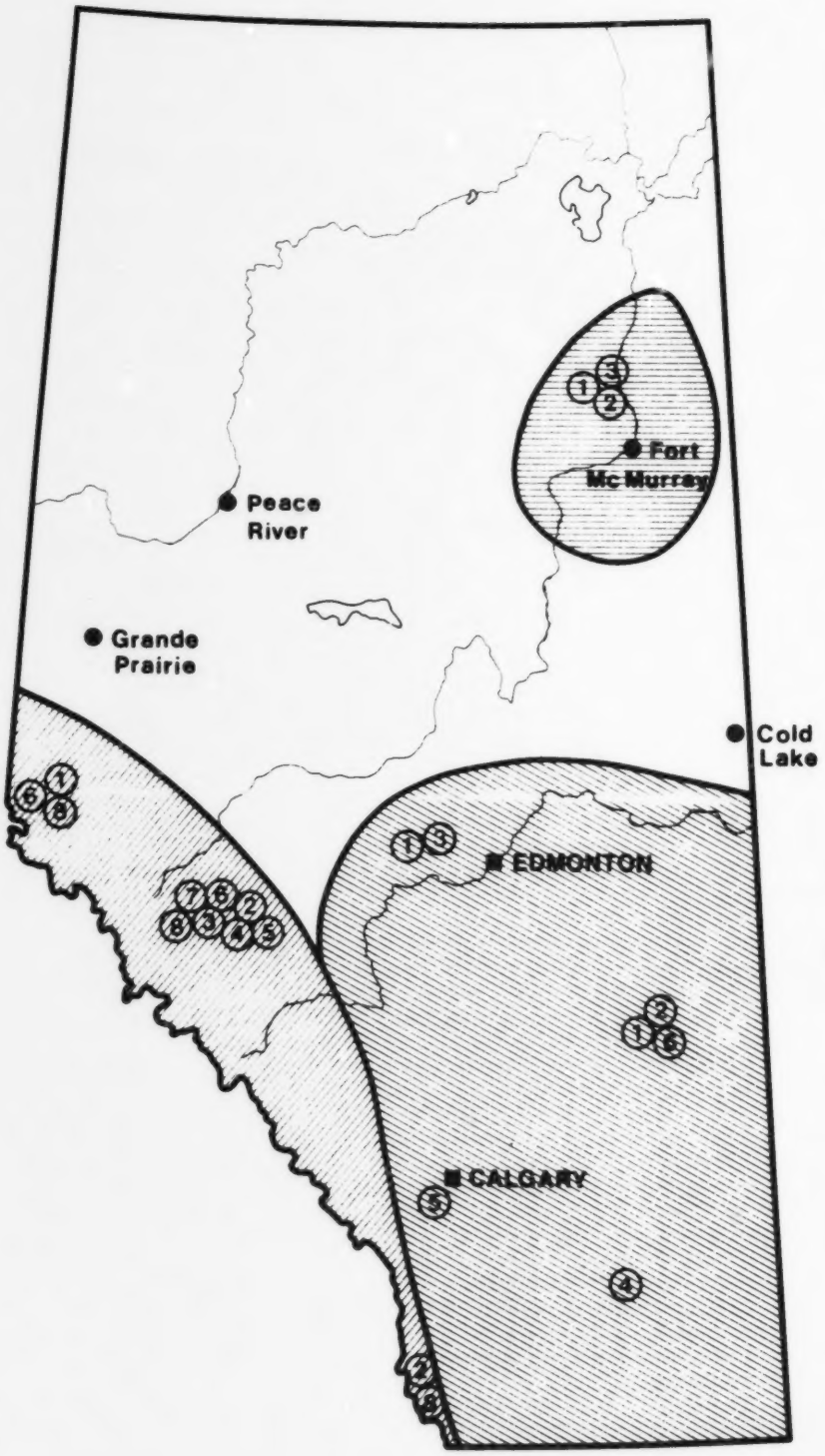


TABLE 1. PRIORITIES & PROGRAM SUMMARY TO DATE, PLAINS AGRICULTURAL LAND

OBJECTIVE: Restoration of Agricultural Capability

PROBLEM AREA	RESEARCH PRIORITIES	PROJECTS	DESCRIPTION	FROM 1 APRIL, 1978 TO 31 MARCH, 1986 RRTAC EXPENDITURES**	INDUSTRY INVOLVEMENT
Groundwater/ Geology	- Effects of Mining on groundwater supplies - Generation of Salts in Spoil - Transport of Salts near the Reclaimed Soil Surface - Subsidence after Reclamation - Effects of underground Ash disposal - Overburden classification	79-2-MOR 79-22-HOD* 79-27-HOD* 80-14-MAR*	The Regions Including and surrounding the Battle River and Highvale Mining areas are being intensively monitored to assess the effects of mining on the Soil, Water and ultimately, the Agricultural Resources. As significant concerns are identified remedial measures are also evaluated. Phase I of the Project is completed. The Long Term effects of subsidence, salinization and soil quality are being monitored.	5,908,735	Joint Management and Project Review through Project Steering Committee, Site Access and information sharing: Alberta Power Ltd. Manalta Coal, Luscar Ltd. and TransAlta Utilities
Soil Reconstruction	- Thickness of Subsoil required above Sodic Spoil - Effects of Slope on lateral salt transport - Reconstruction of Solonetzic Soils - Use of Bottom Ash as Soil Amendment - Effects of different Crops on Thickness Requirements - Changes in Topsoil during stockpiling	82-5-LES 82-13-SCH 79-6-SCH* 79-26-FUJ* 83-4-LAN	Experimental Plots have been constructed on the Battle River and Highvale Mine areas and 1985 will be their fourth and third crop years respectively. The Plots will be intensively monitored annually for five crop years each.	1,157,631	Plot Construction; Joint Management and Project review through Project Steering Committee: Alberta Power Ltd., Luscar Ltd., Manalta Coal and TransAlta Utilities
Fly and Bottom Ash Disposal	- Chemical and Physical Properties of Alberta Fly & Bottom Ashes - Potential for use as Soil Amendment	78-2-MCC* 78-20-MCC* 78-5-P/R* 80-19-MCC*	Ashes from five Alberta Sources were analyzed for both toxicity and Soil Amendment possibilities. This Program is completed and the results are published in Report #RRTAC 81-3.	12,176	Provision of Ash Samples: Alberta Power Ltd., TransAlta Utilities and Saskatchewan Power Ltd.
Oil & Gas Disturbances	- Identify the best methods for handling soil materials in pipeline construction in Agricultural land	81-1-HAS*	A Survey was made of Pipelines of various ages on all of our major Agricultural Soil types. Material handling methods were assessed and problem areas identified. Results are published in Report #RRTAC 83-3.	40,120	A member of the pipeline Industry sat on the Project Mgm't. Committee access to construction records route locations and demonstrations
	- Disposal of Drilling Muds	85-9-LLO*	Literature review of Disposal Methods for KCl Drilling Muds	30,000	
				7,148,662	

*= Completed Projects

TABLE 2. PRIORITIES AND PROGRAM SUMMARY TO DATE, MOUNTAINS & FOOTHILLS COAL MINING

OBJECTIVE: Restoration of Forestry, Wildlife and Watershed Capabilities

PROBLEM AREA	RESEARCH PRIORITIES	PROJECTS	DESCRIPTION	FROM 1 APRIL, 1978 TO 31 MARCH, 1986 RRTAC EXPENDITURES**	INDUSTRY INVOLVEMENT
Landscape Design	Design & Construction of Stable Spoil Dumps	82-14-CHO	Survey of Existing Reclaimed Dumps in Alberta and British Columbia to identify Practical Resloping Strategies	143,702	Site preparation, information sharing
	Water Management	84-12-MON	Identification of settling pond size requirements	25,000	50% funding Coal Association of Canada
Soil Reconstruction	For Commercial Forestry Potential	84-23-PED 84-28-DEM	Literature Review and Evaluation of Seedling Growth in Reforestation Sites and Forest Soil Reconstruction Requirements	30,775 14,975	50% funding Coal Association of Canada
	For Erosion Control on Ash Dumps	79-1-MAC	Thickness of Soil required over Coal Ash to support vegetation	67,691	Plot Construction Smoky River Coal
Revegetation — Herbaceous Cover	Species Selection	79-7-WEI 79-23-WEI 82-12-TOM* 79-5-W/P* 79-18-RUS	Development, assessment and Field Testing of Native Grasses for reclamation. Presentation of known information on Species for Reclamation	572,333	-
	Erosion Control	79-17-TAK 80-11-TAK 78-1-LAR* 82-9-LLO*	Mulches, Binders & Contouring Techniques for erosion control on coal spoil	17,475	-
	Fertilization, Nutrients	82-11-Z/T 78-3-M/P* 79-8-L/R*	Identification of Treatments Important to development of self-sustaining Plant Cover	38,353	-
Tree & Shrub Cover	Propagation	80-16-KIN* 82-1-K/H*	Propagation of Shrubs for Reclamation	20,181	-
	Establishment	79-16-MIH	Establishment of Tree Seedlings in Grass Cover	0	-
	Wildlife Habitat	84-18-LGL	How to reclaim for Wildlife Habitat	14,772	50% funding Coal Association of Canada
				945,257	

TABLE 3. PRIORITIES & PROGRAM SUMMARY TO DATE, NORTHEAST ALBERTA

OBJECTIVE: Restoration of Forestry, Wildlife Capabilities and Erosion Control

PROBLEM AREA	RESEARCH PRIORITIES	PROJECTS	DESCRIPTION	FROM 1 APRIL, 1978 TO 31 MARCH, 1986 RRTAC EXPENDITURES**	INDUSTRY INVOLVEMENT
Soil Reconstruction on Tailings Sand	Identify Recipes for Reconstructed soils suitable for: - Commercial Forest - Non-Commercial Forest - Erosion Control/ - Wildlife Habitat	78-4-PAR* 79-24-OSE* 81-2-PAR 81-3-PAR* 83-10-HAR	Identification of the chemical and Microbiological properties of peat, development of mycorrhizal innoculants for Jack Pine and other woody species, identification of amendment level requirements. The earlier studies are largely complete and were fundamental in designing the Oil Sand Soil Reconstruction Plots (83-10-HAR) which were constructed in 1983.	940,989	Joint Project Development, Management, review and 80% funding of 79-24-OSE. Provision of test site for 81-2-PAR, 50% funding 83-10-HAR
Revegetation	Shrub & Tree - Selection - Propagation - Establishment - Management	79-13-DUN 81-4-P/F* 81-5-WAT* 81-6-K/K* 81-7-ROW*	These projects consist of Tree and Shrub selection, Seed collection, development of Propagation Techniques, and Sampling Methods for use on the Soil Reconstruction Plots to be constructed in 1983.	14,499	Project development, Joint/Management, review and 50% Funding of 81-4,5,6, 100% Funding of 81-7 ROW
				955,488	
Equipment Development	For Incorporation of Tailing Sand Amendments (e.g. Peat, Clay)	(No Formal Projects or Contracts were commissioned under this priority. Rather Government and Industry staff have jointly reviewed available equipment and arranged trials under operational conditions. The evaluation is complete).			
GENERAL***					
Reclamation Review	Document the Findings of Reclamation Research activities and assess implications for Alberta Operations	78-6-SIM* 79-20-WAL* 80-15-SIM* 80-13-WAL*	World wide Reclamation Literature has been reviewed and condensed for presentation in a Report which lists and discusses existing information as pertinent to Reclamation in Alberta. The data base is accessable through The University of Alberta computing system. See Reports #RRTAC 82-1, 81-2 and 84-1.	71,823	
				71,823	
	Total for all RRTAC Programs as of 31 March, 1985			9,121,190	

*** Projects with Province-wide application

1985/86 RECLAMATION RESEARCH

BUDGET

Project	1985/86 Budget ($)
79-1-MAC, Alberta Research Council Revegetation of Ash Disposal Sites	17,320
79-2-MOR, Alberta Research Council Plains Hydrology & Reclamation Program	649,254
81-2-PAR, University of Calgary Mycorrhizal Potential in Reconstructed Soils	79,625
82-5-LES, Pedology Consultants Ltd. Battle River Soil Reconstruction Project	140,000
82-13-SCH, Monenco Consultants Ltd. Highvale Soil Reconstruction Project	132,183
82-14-CHO, Coal Mining Research Company Mountain & Foothills Dump Design	50,000
83-10-HAR, Hardy Associates Ltd. Oil Sand Tailings Soil Reconstruction	52,500
83-4-LAN, Alberta Environment Bottom Ash Amendment to Sodic Spoils	11,554
84-23-PED, Pedocan Soil Reconstruction in Mountain & Foothills Coal Mining	6,000
85-9-LLO, Pedology Consultants Ltd. Land Farming of KCl Drilling Muds	30,000
Total Budget	1,168,436

LAND CONSERVATION

AND

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Mr. D. Fregren	Alberta Energy & Natural Resources Alberta Forest Service, Deputy Chairman
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RECLAMATION RESEARCH

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